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ABSTRACT

Results of the 1980-81 Graduate Student Survey of physics and astronomy students are presented. Information is presented on the following: employment offers for new physics masters and doctorate recipients, 1976-81; characteristics of the graduate physics student population, 1980-81, including sex, citizenship, professional society membership, major of bachelor's degree, type of bachelor's institution, type of graduate institution, student status, and source of support; characteristics of minority group physics students; number of graduate physics students, subfield and year of graduate study completed, 1980-1981; sources of support for graduate physics students, by sex and degree status; number of advanced graduate physics students specializing in selected experimental or theoretical subfields by years of graduate study completed; type of research performed by doctoral candidates with respect to years of graduate study completed; distribution, by subfield and employment offers for doctorate recipients; post-degree plans of physics terminal master's degree recipients; distribution, by subfield, of employment offers for terminal master's; employment characteristics of 1980-81 recipients of master's degrees; background characteristics and post-doctorate status of 1980-81 physics graduates; use of physics in potentially permanent employment of graduate degree recipients; initial employment with potential permanence for 1980-81 physics doctorate recipients; median monthly salaries paid by U.S. employers to new physics graduates; graduate astronomy students by subfield and years of graduate study; characteristics of the graduate astronomy student population; and background characteristics and post-doctorate status of 1980-81 astronomy graduates. (SW)

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1980-81

GRADUATE STUDENT SURVEY

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AIP

1980-81 GRADUATE STUDENT SURVEY

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For the past twenty years graduate physics students have been contacted annually and requested to contribute information to the Graduate Student Survey on their educational backgrounds, their current graduate student status, and their employment prospects where applicable. Seven years ago this survey was extended to include graduate astronomy students who were requested to contribute comparable data. Highlights of this report are:

- one third of the first-year graduate physics students are foreign
- a slight softening in demand for new doctoral physicists after eight years of steady increases in multiple employment offers
- a marked increase in the number of U. S. physics doctorate recipients whose first employers are foreign

—an improvement in employment opportunities for new astronomers

An item of major interest is the demand for new physicists. One way in which the Graduate Student Survey deals with this complex topic is by asking graduate degree recipients for the number of employment offers each received; Figures I and II present an analysis of the findings. The percentage of doctorate recipients without immediate offers remains low; it changed from 2% to 3% in the most recent year shown. Multiple offers declined somewhat from 56% to 52% in that same year, while single offers rose from 42% to 45%.

The demand for new physics masters has always been smaller than that for bachelors or doctors, and 1981 is no exception. An increase from 11% to 13% was reported for those without immediate job offers, but practically no change was recorded by the percentage of masters who received multiple offers.

Figure I. Employment offers for new physics doctorate recipients, 1976-81

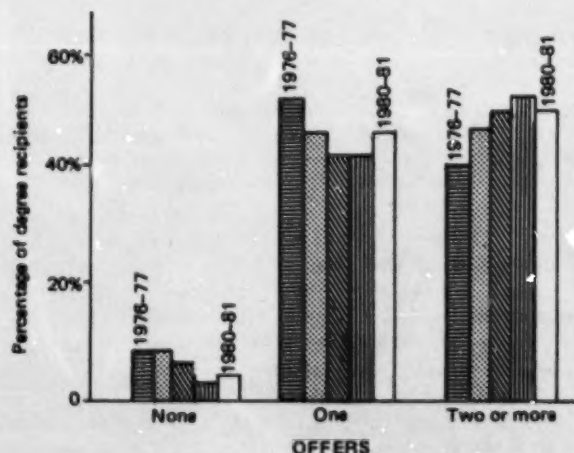
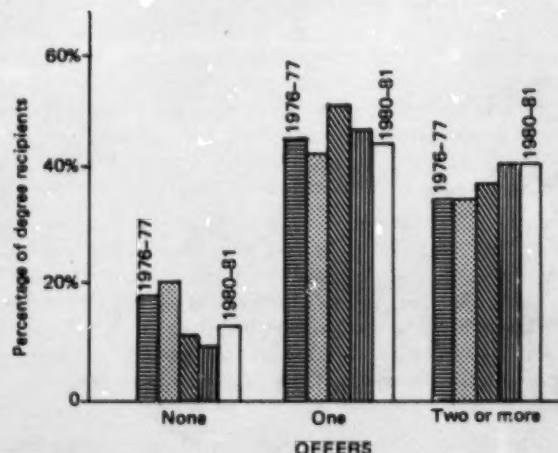


Figure II. Employment offers for new physics masters, 1976-81



MEMBER SOCIETIES:
AMERICAN PHYSICAL SOCIETY • OPTICAL SOCIETY OF AMERICA • ACOUSTICAL SOCIETY OF AMERICA • SOCIETY OF RHEOLOGY • AMERICAN ASSOCIATION OF PHYSICS TEACHERS • AMERICAN CRYSTALLOGRAPHIC ASSOCIATION • AMERICAN ASTRONOMICAL SOCIETY • AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE • AMERICAN VACUUM SOCIETY

Table I. Characteristics of the graduate physics student population, 1980-81.

Characteristics		All graduate students	First-year graduate students	Degree recipients:	
		9934	2564	Terminal masters	Doctorate recipients
*Total population: Number of respondents:		6498	1402	577 324	927 625
Sex	Female	10%	12%	11%	6%
	Male	90	88	89	94
Citizenship	U.S.	73%	67%	86%	74%
	Foreign	27	33	14	26
Professional society membership	Yes	31%	11%	24%	61%
	No	69	89	76	39
Major of bachelor's degree	Physics	89%	84%	87%	92%
	Mathematics	3	3	2	3
	Engineering	4	6	4	3
	Other	4	7	7	2
Type of bachelor's institution	PhD-granting	43%	43%	39%	53%
	MS-granting	9	8	25	5
	BS/BA-granting	19	19	24	18
	Foreign	23	30	12	24
*Type of graduate institution	PhD-granting	88%	87%	73%	100%
	MS-granting	12	13	27	—
*Student status	Full-time	88%	87%	74%	87%
	Part-time	12	13	26	13
Source of support	Teaching assistantship	34%	53%	43%	11%
	Research assistantship	41	16	15	63
	Fellowship	9	10	5	8
	Employment	10	13	24	12
	Family, savings, loan	2	3	5	3
	Other	4	5	5	3

*These data were derived from the Survey of Enrollments and Degrees.

Table I presents eight characteristics, one of which reports on a new question not asked in previous years: The question is membership in a professional society. It appears that approximately one third of all graduate physics students are members of one or more societies. As one might expect only a small fraction of the first-year students belongs to professional societies, but a majority of the doctorate recipients are members.

As the highlights of this report indicate, a rising proportion of the graduate students are foreign, thus citizenship is a characteristic we carefully monitor. The fraction of foreign students among the first-year students has risen to one-third from one-fifth where it was in the early 1970's. Also, the attrition of foreign graduate students is lower than that of U. S. students and very few of them enroll in a terminal master's degree program.

The influx into physics from other disciplines at the graduate school level remains small; the characteristic labeled "Major of bachelor's degree" substantiates this statement by offering details. There is essentially no change from the previous years in the high proportion of graduate physics students who study

on a full-time basis, nor are there changes in their financial support.

Almost one-quarter of the survey respondents specified a minority group with which they identified; thus for purposes of comparison, Table II describes nine minority groups and lists six characteristics for each. For example, the overall percentage of women students is ten; however, Asian Indians and Orientals include a higher percentage of women among their graduate students, while Hispanics and Arabs include fewer than ten percent women. Among the foreign minorities, proportionately fewer graduate students are members of professional societies, and in regard to student status, a smaller proportion of them study part-time.

The major subfields listed in Table II are those which 73% of all graduate physics students specialized in. A similar proportion of the larger foreign minority groups appears to have selected those same subfields. On the other hand, only about 60% of the U. S. blacks and Hispanics chose those same specialties.

Table II. Characteristics of minority group physics students, 1980-81.

Characteristics	Total number:	Black		American Indian	Hispanic				Asian Indian	Oriental		Arab
		U.S.	Foreign		Puerto Rican	Mexican American	Other U.S.	Foreign		U.S.	Foreign	
		70	24	12	21	15	18	121	360	88	612	171
Sex	Female	10	-	2	3	-	2	10	66	15	79	12
	Male	60	24	10	18	15	16	111	294	73	533	159
Degree status	TMS	17	4	2	3	1	6	11	14	4	48	11
	MS and PhD	42	18	8	14	9	11	77	291	63	368	134
	PhD only	11	2	2	4	5	1	33	55	21	196	26
Student status	Full-time	48	24	10	18	10	13	118	348	85	580	163
	Part-time	22	-	2	3	5	5	3	12	3	32	8
Prof'l society membership	Yes	26	3	9	3	5	3	34	86	29	97	27
	No	44	21	3	18	10	15	87	274	59	515	144
Full-time equivalent years of graduate study	<1	14	5	2	5	3	4	20	59	21	126	16
	2	18	7	4	3	3	8	18	61	11	138	38
	3	11	4	-	5	4	2	25	64	13	92	42
	4	6	1	-	4	4	1	28	57	11	83	28
	5	7	3	1	2	-	1	15	51	16	80	28
	>5	14	4	5	2	1	2	15	68	16	93	19
Major subfields	Elem. particles	2	1	4	2	2	-	20	34	15	79	15
	Nuclear	5	4	-	1	-	1	8	41	5	43	19
	Optics	5	-	-	2	-	2	4	22	4	45	9
	Solid state	20	10	2	6	3	7	43	139	32	235	57
	Cross-discipl. areas	6	2	4	1	-	3	9	28	7	45	13
	General physics (ed)	8	-	-	-	1	1	5	5	2	22	7
Graduate degree recipients	TMS	←12→		1	1	0	←8→		4	←20→		7
	Doctorates	←11→		0	1	1	←8→		40	←70→		10

The data in Table III were scaled up to reflect the total number of graduate physics students in each of the major subfields and at nine levels of graduate study. Therefore, using this table, it is possible to estimate the number of graduates within major subfields who will be in the employment market short-

ly. The median number of years of graduate study spent to get a physics doctorate is 5.2. The overall distribution of subfields has changed little from previous years, but among the first-year students, biophysics and optics attracted a slightly larger proportion in 1980-81 than in the previous year.

Table III. Number of graduate physics students, by subfield and years of graduate study completed, 1980-81.

		Full-time equivalent years of graduate study									Total graduate students	
		< 1 yr.	2 yrs.	3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	8 yrs.	> 8 yrs.	N	%
Distribution* of students	N %	2564	1937	1470	1301	1162	785	407	169	139	9934**	100%
		25.8	19.5	14.8	13.1	11.7	7.9	4.1	1.7	1.4		
Astrophysics		133	85	91	81	78	30	22	11	8	539	5.2
Biophysics/ radiology		108	64	38	34	40	26	15	9	4	338	3.4
Electron, atomic, molecular		116	124	103	107	114	89	45	17	26	741	7.5
Elem. particles		286	198	156	198	177	114	55	29	11	1224	12.2
Math. physics		205	142	122	82	57	26	18	5	6	663	6.7
Nuclear physics		175	163	134	118	93	62	29	18	8	800	8.1
Optics		192	147	98	68	44	33	16	8	5	611	6.2
Plasma physics		100	68	65	69	75	49	36	15	8	485	4.9
Solid state		591	533	451	430	375	276	135	49	50	2890	29.1
General physics		274	134	29	9	3	3	2	-	-	454	4.6
Other subfields		384	279	183	105	106	77	34	8	13	1189	12.1

*The distribution of students in each subfield is based on 6368 respondents to this question.

**The total was derived from the Survey of Enrollments and Degrees.

Table IV. Sources of support for graduate physics students, by sex and degree status 1980-81.

Source of support	Female	Male	Terminal master's	Candidates for:			Total	
				Master's enroute to PhD	PhD after master's	PhD only	N	%
Teaching assistantship	41%	33%	43%	46%	24%	34%	2209	34%
Research assistantship	33	42	12	28	53	46	2668	41
Fellowship	10	8	4	8	9	12	585	9
Employment	9	10	28	9	8	4	643	10
Family, savings, loan	3	2	6	4	1	1	134	2
Other	2	3	4	3	3	1	136	2
Multiple sources of support, primarily with teaching assistantships	2	2	3	2	2	2	123	2
	100%	100%	100%	100%	100%	100%		
Total respondents	N 677	5821	796	1378	2697	1627	6498	100%
	% 10	90	12	21	42	25		

Candidacy for a specific degree influences the source of support a graduate physics student can expect to receive. The terminal master's degree candidates for example are less likely to be offered fellowships or research assistantships, and have the highest proportion of degree candidates who support themselves through off-campus employment. These data and others are presented in Table IV which also shows that women gradu-

ate students are less likely to be granted research assistantships than male graduate students; a check revealed that this difference in research assistantships is also true for the two groups of degree recipients. For the academic year 1980-81, "family, savings or loans," as sources of support, continue to be reported by few graduate students.

Table V. Number* of advanced graduate physics students specializing in selected experimental or theoretical subfields by years of graduate study completed, 1980-81.

Physics subfields	Type of research	Full-time equivalent years of graduate study							N	Total	
		3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	8 yrs.	> 9 yrs.		%	%
Astrophysics	experimental	54	25	33	16	10	4	2	144	4.8	
	theoretical	29	23	27	13	8	2	4	106		6.6
Biophysics	experimental	18	27	23	16	10	8	-	102	3.4	
Electron, atomic molecular	experimental	66	60	70	52	33	15	8	304	10.2	
	theoretical	16	25	33	27	8	-	2	111		6.9
Elem. particles	experimental	77	107	115	73	34	17	4	427	14.3	
	theoretical	71	81	63	46	21	14	6	302		18.8
Math. physics	theoretical	129	79	54	27	17	6	8	320		19.9
Nuclear	experimental	102	58	75	38	21	11	4	309	10.4	
	theoretical	21	34	19	21	8	6	2	111		6.9
Optics	experimental	47	43	23	16	8	6	4	147	4.9	
Plasmas	experimental	27	31	37	21	25	10	4	155	5.2	
	theoretical	33	31	27	13	13	4	-	121		7.5
Solid state	experimental	298	279	263	199	80	39	25	1183	39.6	
	theoretical	85	102	73	48	23	6	2	339		21.0
Other subfields	experimental	75	42	45	42	6	1	6	217	7.2	
	theoretical	70	48	32	22	25	2	1	200		12.4
Total**	experimental	764	672	684	473	227	111	57	2688	100.0%	
	theoretical	454	423	328	217	123	40	25	1610		100.0%

*The numbers in this table have been scaled up to reflect the total number of graduate students (5433) who completed three or more years of graduate study.

**In addition to the graduate students working on an experimental or theoretical thesis there are an estimated 835 graduate physics students who describe their studies as both experimental and theoretical.

Table VI. Type of research performed by doctoral candidates with respect to years of graduate study completed, 1980-81.

Type of research	Full-time equivalent years of graduate study			Total	
	3 or 4 yrs.	5 or 6 yrs.	> 7 yrs.	> 3 yrs.	
Experimental	52%	59%	58%	55%	2988
Theoretical	31	28	27	30	1610
Both	17	13	15	15	835
Total	100%	100%	100%	100%	
Number of students	2776	1971	686		5433

The questionnaire sent to each graduate physics student requests him or her to indicate a type of research (i.e. experimental or theoretical) as well as an area of concentration; however, only from the third year on, do questions concerning type and subfield of research become meaningful. Table V presents an array of doctoral candidate group.3 by type of research, subfield, and years of graduate study completed. Noteworthy changes from the previous year include an increase in the number of graduate students who specialize in astrophysics, and a decrease in third-year theoreticians who chose nuclear, electron, atomic, molecular, or solid state physics as their specialties.

Combining all subfields Table VI focuses on the types of research and shows that theoreticians require less time than experimentalists to complete their doctoral theses.

On the assumption that temporary postdoctoral fellowships are readily available, a frequent question asked by graduate students is: With which subfields are doctoral graduates more

likely to be offered potentially permanent positions? The data in Table VII present the proportion of 'postdocs' to those seeking and accepting permanent positions for each of the major subfields. For example, a majority of the elementary particle graduates accepted 'postdocs', whereas optics graduates were more likely to be offered permanent employment. Table VII also shows that more than twice as many experimentalists as theoreticians were offered potentially permanent positions. These numbers are estimated totals and do not include the estimated number of 112 new physicists who described their dissertations as both experimental and theoretical.

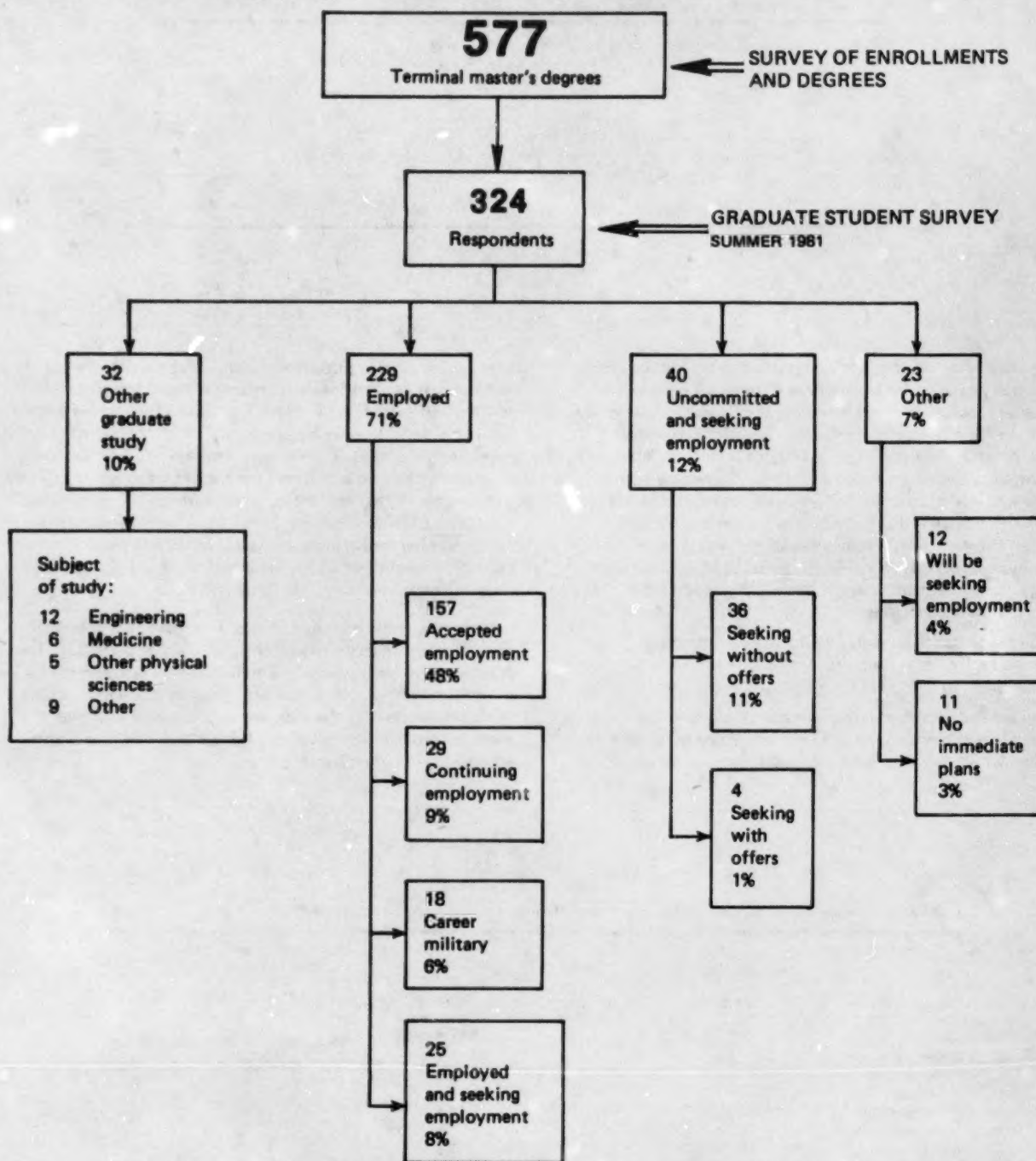
Noteworthy is the apparent change in demand for theoreticians from prior years. As recently as 1978 and 1979, 10% of the doctorate recipients who completed theoretical dissertations reported zero job offers shortly after graduation; those same percentages for the experimentalists were four and seven percentage-points lower. Table VII shows that a difference of that kind no longer exists.

Table VII. Distribution, by subfield and employment offers for doctorate recipients, 1980-1981.

Physics subfield	Total in subfield	Employment-oriented graduates	New 'postdocs'	Percentage of graduates within subfield received:		
				0 offer	1 offer	> 2 offers
Astrophysics	4.3%	2.4%	1.9%	4%	41%	55%
Biophysics/radiology	3.1	1.6	1.5	0	59	41
Electron, atomic molecular	8.4	5.5	2.9	2	51	47
Elem. particles	17.3	7.2	10.1	1	41	58
Math. physics	4.7	3.1	1.6	7	20	73
Nuclear	9.3	5.5	3.8	3	27	60
Optics	5.1	4.1	1.0	3	28	69
Plasmas, fluids	6.7	5.6	1.1	2	41	57
Solid state	33.4	21.4	12.0	2	42	56
All other subfields	7.7	5.0	2.7	0	48	52
%	100.0%	61.4%	38.6%	3%	45%	52%
N	906*					
All experimental subfields		326	184	3%	48%	49%
All theoretical subfields		136	148	2%	43%	55%

*This group does not include the estimated 21 graduates who were not interested in immediate employment, (see Figure IV).

Fig. III. Post-degree plans of physics terminal master's degree recipients, 1980-81.



Students who have chosen to terminate their study of physics at the master's level generally fall into two major categories: 1) those who decide to do graduate work in another discipline, and 2) those who decide to take advantage of a favorable job market. Figure III shows that of the 1981 terminal masters, approximately 70% fall into the second category, and elaborates to some extent on the type of employment and the degree of satisfaction expressed by that group. The 25 graduates who reported being employed but were still seeking employment,

form a larger group this year than last year, and only half as many masters expressed interest in a military career. The group still uncommitted and seeking employment shortly after graduation increased by two percentage-points from the previous year.

The proportion of masters who transferred to "other graduate study" decreased from 16% to 10% in the most recent year, and engineering remains the most frequently cited discipline they transferred to.

Table VIII. Distribution, by subfield, of employment offers for terminal masters, 1980-81.

Physics subfield	Total in subfield*	Percentage of graduates within subfield received:		
		0 offer	1 offer	> 2 offers
Astrophysics	3.0%	13%	38%	49%
Biophysics/radiology	2.2	0	33	67
Electron, atomic molecular	7.4	15	40	45
Engr. and applied physics	8.2	5	70	25
Nuclear physics	7.1	21	42	37
Optics	16.0	9	63	28
Plasmas, fluids	3.0	13	50	37
Solid state	22.3	7	50	43
General physics	13.4	33	42	25
All other subfields	17.4	12	39	49
Total	100.0%	13%	47%	40%
Employment-oriented respondents		36	126	107

*Based on 324 survey respondents

By focusing only on the "employed" and "uncommitted" groups of Figure III we constructed Table VIII which relates the employment offers to the subfields those masters pursued in graduate school. Assuming that employment offers shortly after graduation are a measure of the demand for that type of physicist, those masters who selected a cross-disciplinary area of physics appear to have made one of the best choices. Biophysics/radiology is included in Table VIII, but similar proportions of job offers were reported by geophysicists, atmospheric, and environmental physicists. On the other hand, those 13% of the masters who chose not to specialize and listed themselves under "general physics", reported the highest percentage of "zero job offers".

Most of the masters who reported job offers had already started their employment and consequently were in a position to describe the type of employer and work activity associated with each offer. But even those who had not yet started their employment gave descriptions which enabled us to include them in Table IX. The data in this table point to no major changes in employment from previous years. Industry remains the largest employer of master's level physicists, with a further decline in secondary school teaching (from 5% to 3%), and a moderate increase in the number of new physics masters who secured employment at universities.

Table IX. Employment characteristics of 1980-81 recipients of master's degrees.

Work activity	Sec. school	Coll.	Univ.	Industry	Gov't inc. mil.	FFRC	Nonprofit organ.	Total N	%
Teaching	7	5	10	-	2	-	-	24	10
Research	-	-	10	9	5	3	1	28	12
Res. and dev.	-	-	1	51	13	3	2	70	30
Engineering*	-	-	4	53	6	1	-	64	27
Computer scie.	-	-	6	10	-	-	-	16	7
Nonphysics prof'l	-	-	-	8	5	-	-	13	6
Other	-	-	-	8	8	-	2	18	8
N	7	5	31	139	39	7	5	233	
Total									
%	3	2	13	60	17	3	2		100%

*Engineering includes those who checked development only.

Fig. IV. Background characteristics and post-doctorate status of 1980-81 physics graduates.

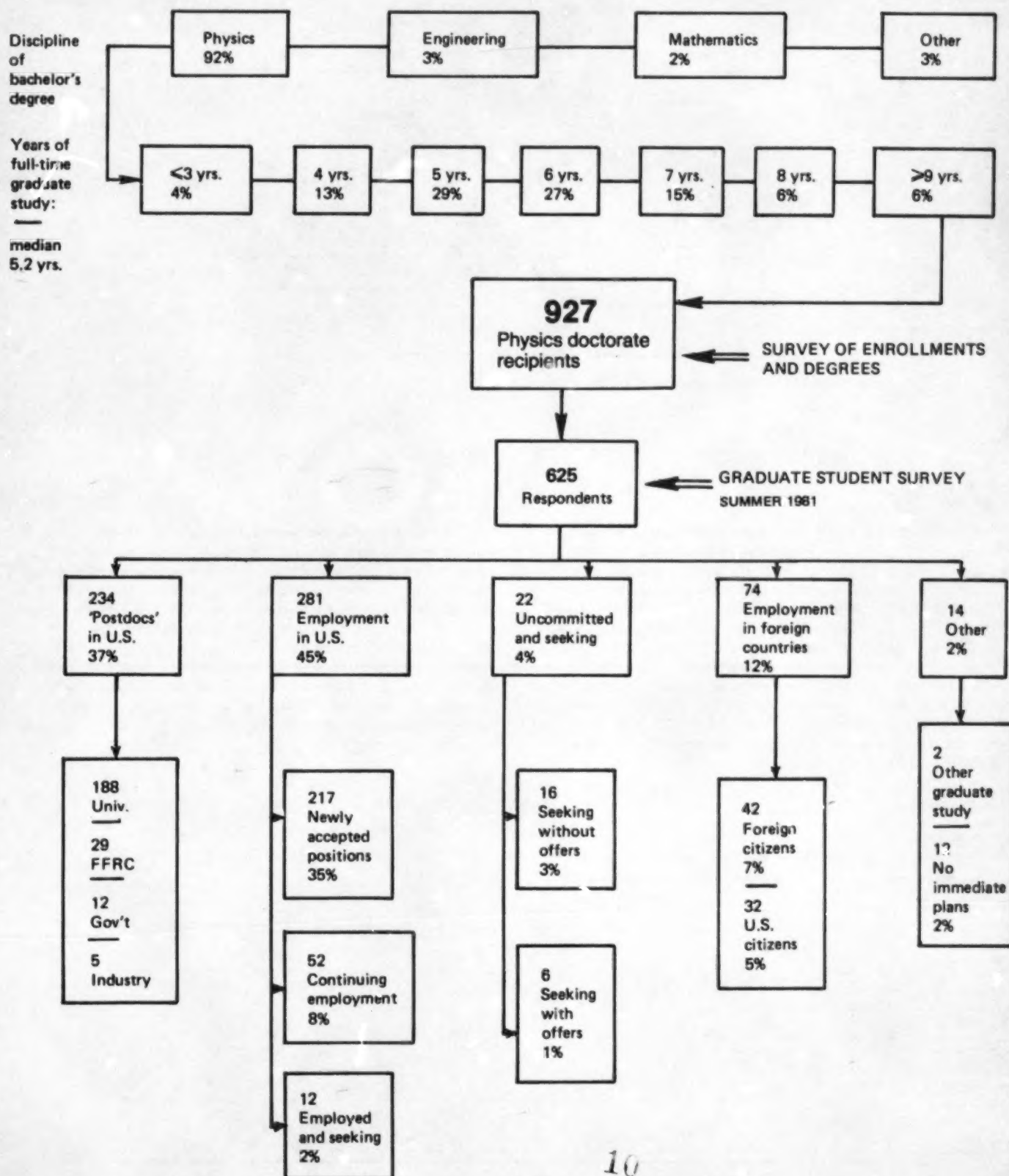


Table X. Use of physics in potentially permanent employment of graduate degree recipients, 1980-81.

		<u>Extensive use of physics training with respect to:</u>		<u>Number responding to question</u>
<u>Major employer</u>		<u>method</u>	<u>subject matter</u>	
Doctorate recipients	University	89%	92%	37
	College	100	86	7
	Industry	77	56	145
	FFRC	91	91	22
	Government	85	71	21
<u>Total</u>		<u>81%</u>	<u>67%</u>	<u>232</u>

		<u>Use of physics training with respect to subject matter:</u>			<u>Number reporting</u>
		<u>Extensive</u>	<u>Little</u>	<u>None</u>	
Terminal masters	Educational inst.	75%	22%	3%	36
	Industry	38	58	4	105
	FFRC/Gov't	70	30	-	33
	<u>Total</u>	<u>52%</u>	<u>45%</u>	<u>3%</u>	<u>174</u>

As in past years, the flow diagram of Figure IV presents both background characteristics and post-doctorate plans; but new for the 1980-81 graduates is the distinction presented in this figure between employment in the U. S. and foreign countries irrespective of citizenship. In previous years foreign employment included only foreign graduates who returned to their native countries, but this year the number of doctoral graduates who, as U. S. citizens, started employment in a foreign country, has risen sharply; hence this number is included as a separate item. Although still small, the number of doctoral graduates without immediate plans has more than doubled.

Most of the employment-oriented degree recipients in this Graduate Student Survey completed their questionnaires after starting their employment, hence it seemed reasonable to ask them to evaluate the extent to which they are using their physics training. Table X is based on the responses to that evaluation question but excludes the answers from 'postdocs'. In general, graduates who accept postdoctoral fellowships do so to continue the research on which their dissertations were based and a very high proportion of them are making extensive use of their training. For that reason, Table X includes only doctoral graduates who started their potentially permanent employment, and new physics masters.

Although both groups of degree recipients answered the question which distinguishes between use of subject matter and research method, only the research activities of doctorate recipients called for an evaluation in terms of subject matter as well as method. On the other hand, three levels of utilizing the subject matter of one's training, seemed an appropriate evaluation for the work activities of masters.

For both groups of degree recipients shown in Table X industry is associated with the lowest percentage of "extensive use of training" among the major employers listed. Comparing the averages for all employers combined with those of the previous year, a smaller proportion of doctors reported "extensive use" while evaluations from the terminal masters did not change significantly from the previous year.

To determine why fewer industrial physicists refer to their work as making "extensive use" of their training, Table XI relates the employers to the work activities and shows that only 26 out of the 152 new doctoral physicists in industry (or 17%) are doing research exclusively. Of the total group of doctoral graduates with potentially permanent positions only one-quarter reported research as their major work activity; two years earlier that fraction was close to one-third. Nonphysics professional work has remained at 3% since the early 1970's.

Table XI. Initial employment with potential permanence for 1980-81 physics doctorate recipients.

Work activity	Type of employer							Non-profit org.	Total	
	Tenurable	Non-tenurable	Coll.	Industry	FFRC	Gov't			N	%
Teaching	4	4	5	-	-	-	-	-	13	5.1
Research	2	8	-	26	13	-	4	-	64	25.0
Res. and teaching	11	7	2	-	-	1	-	-	21	8.2
Res. and dev.	-	2	-	80	10	12	3	-	107	41.8
Engr.	-	-	-	28	2	-	-	-	30	11.7
Nonphysics prof'l	-	-	-	6	-	-	2	-	8	3.1
Other	-	-	-	12	-	1	-	-	13	5.1
N	17	21	7	152	25	25	9	-	256	
Total	%	6.6	8.2	2.7	59.4	9.8	9.8	3.5		100.0%

Table XII. Median monthly salaries* paid by U.S. employers to new physics graduates, 1980-81.

Type of employer	Bachelor's degree recipients		Terminal master's degree recipients		Doctorate recipients			
	Percentage accepting positions	Monthly starting salaries	Percentage accepting positions	Monthly starting salaries	Percentage accepting: 'Postdocs'	Potentially perm. pos.	Monthly starting salaries for: 'Postdocs'	Potentially perm. pos.
Secondary school	2%	\$1050	2%	**	—	—	—	—
4-year college	—	—	3	**	1	1%	—	**
University	4	1180	12	\$1500	43%	5	\$1380	\$1900
Industry	62	1820	61	1980	1	29	**	2545
Government incl. Military	28	1270	18	1675	3	4	1780	2300
Fed. Funded Res. Ctr.	2	1700	3	**	7	4	1670	2580
Other	2	**	1	**	—	2	**	**
All employers	100%	\$1660	100%	\$1900	100%		\$1460	\$2470

*Salaries shown in this table are based on newly accepted positions.

**Fewer than ten graduates reported salaries.

Starting salaries are presented in Table XII and include only those of graduates who accepted new positions; degree recipients who continued their work with the same employer and without a promotion to a new position are excluded from this table. Though not collected as part of this survey, we included the starting salaries of new physics bachelors in Table XII for the purpose of comparison. The median monthly salary of new masters has risen by 9% between 1980 and 1981. Only ten women among the masters reported salaries; eight of them had accepted industrial positions with a median monthly salary of \$2,000.—

Postdoctoral fellowships always entail a lower salary than positions with potential permanence, therefore Table XII presents the two groups of salaries in separate columns. The overall increase from the previous year is 11% for the fellowships most of which are paid by universities; the doctoral positions with potential permanence showed an increase of 12%. Industrial positions which, traditionally had always paid the highest salaries, were matched by the salaries offered at federally funded research centers. However, only 4% of the new doctoral graduates were offered positions at the FFRC's, whereas industry absorbed almost 30% of the doctoral class of 1981.

ASTRONOMY

The 50 graduate astronomy departments enrolled almost 700 astronomy students during the academic year 1980-81; over 500 of those students contributed the data presented in this part of the Graduate Student Survey report.

The distribution of astronomy students by level of graduate study is shown in Table XIII which relates those levels to nine major subfields including astrophysics. Cosmology continues to be the subfield which attracts the largest number of students.

Table XIII. Graduate astronomy students* by subfield and years of graduate study, 1980-81.

	N	Full-time equivalent years of graduate study						Total graduate students	
		<1 yr.	2 yrs.	3 yrs.	4 yrs.	5 yrs.	>6 yrs.	N	%
Distribution of students		164	130	89	96	103	104	686	100%
		24%	19%	13%	14%	15%	15%		
Astronomy subfields									
Astronomical instruments and techniques		3%	8%	4%	4%	—	3%	27	4%
Cosmology, extragalactic objects, quasi-stellar objects	22		22	16	17	29	23	144	21
Galactic structure, stellar motions	8		11	9	11	4	6	55	8
Interstellar matter and gaseous nebulae	8		10	22	13	12	13	82	12
Solar system, space astronomy of the solar system	12		5	6	13	11	4	62	9
Stellar atmosphere and spectra, stellar evolution, solar and stellar interiors	9		12	12	16	24	32	117	17
Supernovae, X, γ and cosmic rays, pulsars	5		6	9	4	5	6	41	6
The sun	2		4	2	6	1	3	21	3
Astrophysics	19		17	5	10	9	5	82	12
All other subfields combined	12		5	15	6	5	5	55	8
		100%	100%	100%	100%	100%	100%		100%

*The percentages shown in this table are based on 510 respondents to the Graduate Student Survey. Astronomy department chairmen reported a total of 686 graduate students for the Survey of Enrollments and Degrees.

Background, as well as other characteristics of all graduate astronomy students are presented in Table XIV, which compares three subgroups with the total student population. The new characteristic listed this year is "membership in a professional society", and a significantly higher proportion of the astronomy students, than the physics students, are members. For example, only 31% of all graduate physics students belonged to a professional society compared with the 42% shown in Table XIV. For first-year students that difference is even greater because only 11% of the physics students report

society membership compared with 24% of the beginning astronomy students.

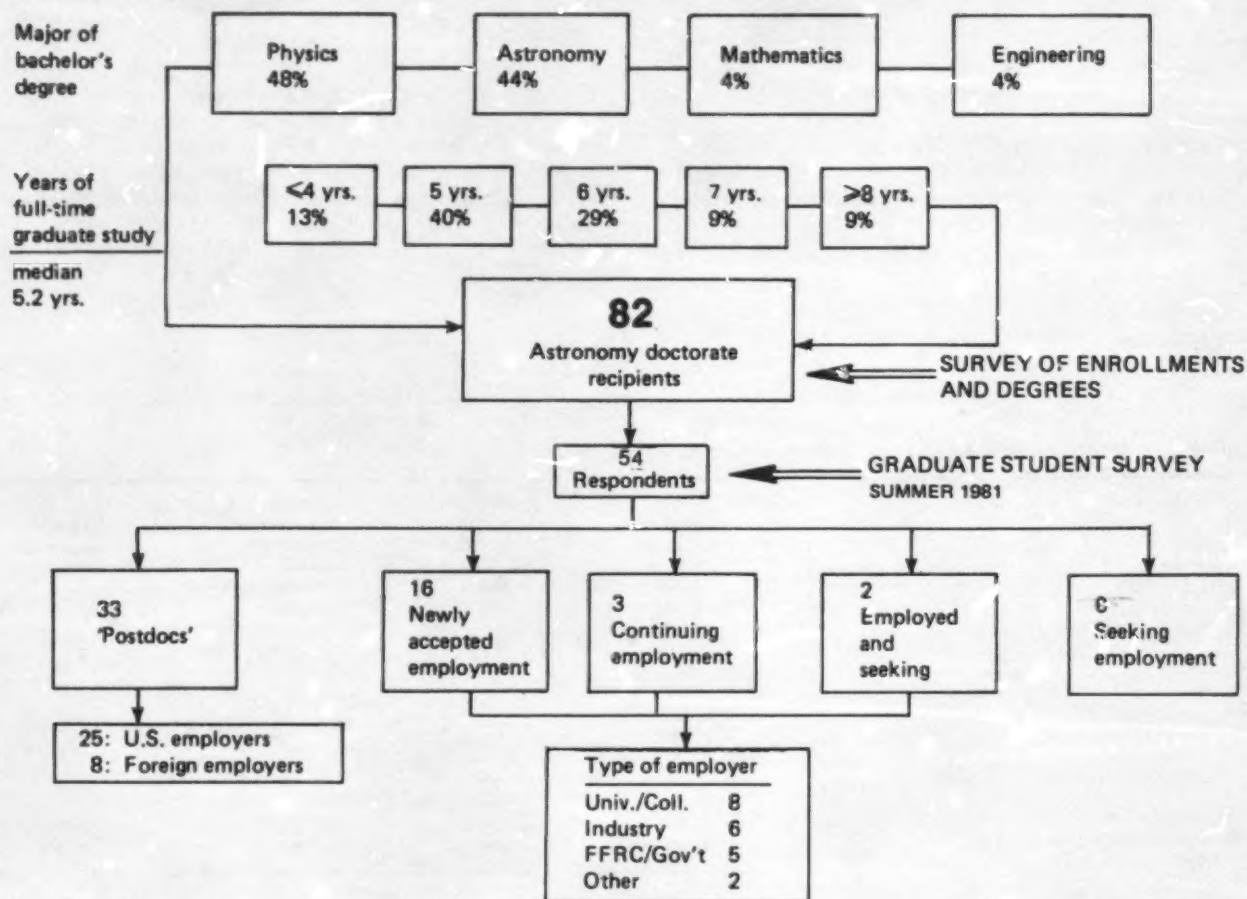
Comparisons of characteristics with the previous year indicate that the first-year students who entered in the fall of 1980 included higher proportions of undergraduate astronomy majors (a 7 percentage-point increase), of students from foreign institutions (a 4 percentage-point increase), and of students with assistantships (a 14 percentage-point increase).

Table XIV. Characteristics of the graduate astronomy student population, 1980-81.

Characteristics		All graduate students	First-year graduate students	Degree recipients	
				Terminal masters	Doctorate recipients
*Total population: Number of respondents		686 510	164 121	24 10	82 54
Sex	Female	13%	12%	30%	6
	Male	87	88	70	94
Citizenship	U.S.	86%	85%	90%	87%
	Foreign	14	15	10	13
Membership in a prof'l society	Yes	42%	24%	15%	84%
	No	58	76	85	16
Major of bachelor's degree	Astronomy	36%	37%	50%	44%
	Physics	58	53	40	48
	Mathematics	3	3	—	4
	Engineering	2	3	—	4
	Other	3	4	10	—
Type of bachelor's institution	PhD-granting	65%	66%	50%	67%
	MS-granting	5	7	10	—
	BS/BA-granting	18	13	30	23
	Foreign	12	14	10	10
*Type of graduate institution	PhD-granting	96%	93%	100%	100%
	MS-granting	4	7	—	—
Student status	Full-time	94%	93%	100%	85%
	Part-time	6	7	—	15
Source of support	Teaching assist.	30%	51%	70%	10%
	Research assist.	44	16	10	63
	Fellowship	15	21	20	4
	Employment	5	5	—	12
	Family, saving, loan	3	4	—	6
	Other	3	3	—	5

* These data were reported by astronomy department chairmen as part of the Survey of Enrollments and Degrees

Fig. V. Background characteristics and post-doctorate status of 1980-81 astronomy graduates.



In addition to the characteristics of doctorate recipients listed in Table XIV, Figure V focuses on the employment status of those new astronomers. According to our records which began in 1975-76, the class of 1981 included the lowest number of doctors; however, it is the first class in which each respondent

reported some form of employment. To illustrate that finding the flow diagram of Figure V includes a zero in the box labeled "seeking employment". The number of graduates who accepted 'postdocs' is similar to that of the previous year, but this year we added information on the number leaving the U.S.

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